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Abstract

This paper applies for the first time an extended FABEER model to China, in order to investigate the determinants of the equilibrium nominal CNY/USD exchange rate and the misalignments of the Renminbi for both pre- and post-reform periods. We extend the FABEER model to include eleven of China's main trade partners which account for 82% of its foreign trade. Second, we model and estimate the sustainable current account and the trade equations by employing a unique data set of consistent time series for economic fundamentals, trade-related variables and Euro variables since 1960. The results show that the sustainable and trend current accounts for China have been positive and rising during the post-reform period, accelerating particularly since the middle of 1990s. The nominal RMB was overvalued against the US dollar throughout the pre-reform period, but was undervalued and less volatile during the post-reform period. The undervaluation became more persistent and rising since 2000, but the misalignment rates are considerably smaller than those suggested by previous studies. Our empirical findings imply that a gradual increase in the flexibility of the exchange rate system rather than a sudden switch to a floating system would be more feasible for China over the near future.

Key Words: FABEER model; Fundamental equilibrium exchange rate; Nominal CNY/USD; China; Pre- and post-reform periods

JEL Classification: F31, F32, C51 C52, O53

1. Introduction

China's mounting trade surplus with the USA has led many politicians and academics in the USA to claim that China enjoys an unfair competitiveness advantage due to a deliberate policy of keeping its currency, Renminbi (RMB)[1], undervalued. To what extend is this claim accurate? To answer this question, we investigate the equilibrium bilateral nominal exchange rate between the RMB and the US dollar and analyse the misalignments in the RMB. Our research is motivated partly by the important implications for China's exchange rate policy and international competitiveness, and partly by the need to address a number of limitations in the existing literature.

The existing literature on the equilibrium exchange rate of China often focuses on the real exchange rate[2]. But it is the nominal exchange rate, rather than the real exchange rate, that is adjusted by the government and used as a policy instrument. To our knowledge, only three papers examine the equilibrium nominal exchange rate (CNY/USD); i.e. Jeong and Mazier (2003), Wren-Lewis (2004a) and Funke and Rahn (2004). Theoretically, the equilibrium nominal exchange rate is modelled along the lines of the Five Area Bilateral Equilibrium Exchange Rate (FABEER) model of Wren-Lewis (2003, 2004a), which has not been applied to China except for one year, 2002, by Wren-Lewis (2004a). We extend the FABEER model from several perspectives to make it applicable to China.

First, Wren-Lewis (2004a) includes China in the FABEER model of the major four countries (i.e. US, Euro area, Japan, UK), with China modelled recursively. Hence movements in the Chinese economy have no impact on other blocs, based on the

[1] Renminbi (RMB) is the name of the Chinese currency. Yuan is the unit of the currency. In the foreign exchange market, the exchange rate is measured as CNY against other currencies (e.g. US dollar). But when Chinese authorities refer to appreciation, depreciation, overvaluation, undervaluation and equilibrium value of the currency, they are referring to the RMB.

[2] For a review of previous studies for China, see You (2008) and You and Sarantis (2008c, 2009a).

assumption that China is a small country. In our extended FABEER model, China is clearly the country of interest. The criterion for choosing other economic blocs is that any economic bloc that has aggregate trade with China that accounts for more than 1% of China's total trade during the sample period is included. Based on such a criterion, apart from China, 11 other blocs are included in the model: Australia, Canada, Euro area, Hong Kong, Japan, Korea, Malaysia, Singapore, Thailand, United States and the United Kingdom . These countries account for 82% of China's total foreign trade (see You, 2008).

Second, in Wren-Lewis (2004a) the sustainable current account is assumed to be certain percentage of output (either 0% or 1% of GDP). Assuming the sustainable current account to be a certain fixed percentage of GDP may be plausible for a single year, but it could be misleading for the whole sample period as the sustainable current account evolves during the sample period, reflecting the evolution of the fundamentals. In our study, we model and estimate the sustainable current account as savings minus investment based on individual savings and investment functions. This allows us to estimate the sustainable current account that is determined by economic fundamentals that reflect the unique features of the Chinese economy and which have not been employed by previous studies.

Third, there is no breakdown of trade values into volumes and prices for China in Wren-Lewis (2004a). Also the coefficients in the trade value equations are calibrated rather than estimated. Though calibrated coefficients are obtained based on existing studies, it is argued by Wren-Lewis (2003) that it could be a limitation of the model. In our study, we split trade values into volumes and prices. We therefore construct consistent time series for export/import volumes and prices for China, and all trade equations are estimated.

We make two further contributions to the literature on China's equilibrium exchange rate. First, all previous studies are restricted to the post-reform period (i.e. last twenty years) or the period after 2000, as in Wren-Lewis (2004a). As a result, they miss the opportunity to provide a comparative analysis of the misalignments not only between the centrally-planned pre-reform period and the market-oriented post-reform period (after 1978), but also amongst different periods of nominal exchange rate adjustments[3]. Therefore, to be able to carry out such a comparative analysis and provide policy implications accordingly, we cover both pre- and post-reform periods (1960-2005).

Second, we construct a unique data set of consistent time series for China since 1960. The data base consists of trade-related variables (i.e. export and import prices, export and import volumes, competitiveness, commodity prices, real output, domestic price) and economic fundamentals which have not been employed by previous studies. In addition, import volumes and export prices are constructed for China's 11 trade partners for the same sample period. Such a data base enables us to estimate the income and price elasticities of China's international trade, examine the determinants of the sustainable current account, and investigate the misalignments in the nominal RMB against the USA dollar for both the pre-reform and post-reform periods.

The paper is organised as follows. Section 2 sets out the extended FABEER model for China. Section 3 presents and analyses the econometric estimates of the trend and sustainable current accounts. Section 4 investigates the misalignments in the nominal RMB. Section 5 summarises the empirical findings and discusses their policy implications.

[3] For a summary of China's exchange rate regimes since the 1950s, see Table 1.

2. The Extended FABEER Model for China

The FABEER model of Wren-Lewis (2003) works with bilateral nominal exchange rates directly. The five areas are the US, Euro area, UK, Japan (referred as major four countries afterwards) and the rest of the world. For each bloc, the model contains trade volume equations and trade prices equations, plus manufacturing trade prices equations. In each case trade is split between exports and imports. Together with an equation for net IPD flows, this provides a complete model of the current account for each bloc, conditional on exogenous inputs for output, commodity prices, interest rates, assets stocks, and of course the exchange rate itself. The model is solved for an equilibrium exchange rate by finding the set of bilateral nominal exchange rates that deliver trend current accounts compatible with the exogenous assumptions about the sustainable current accounts. Interactions amongst blocs occur through two routes in the model. The first is through import volumes, which determine other countries' export volumes. The second is through export prices, which influence both the competitiveness of other countries' export and domestic output as well as import prices.

2.1. Trend Current Account

The trend current account consists of full trend trade balance, trend interest profits and dividends (IPD) flows and the trend net transfer. The difference between trend trade balance and full trend trade balance is that the former satisfies the internal balance condition and the latter in addition takes into account the trend effect of China's main trade partners on China.

2.1.1. Full Trend Net Trade Balance

In the FABEER model of Wren-Lewis (2003), the export (X) and import (M) volumes, and the export (XP) and import (MP) prices of country i are expressed as

$$X_i = (\sum_{i \neq j} M_j, XCOM_i) \Rightarrow X_i = (\sum_{i \neq j} M_j, \frac{\sum_{j \neq i} h_{ij} MXP_j}{MXP_i}) \quad \textit{export volume equation} \quad (1)$$

$$XP_i = \left[\left(\sum_{j \neq i} h_{ij} MXP_j \right)^{\gamma} (P_i / N_i)^{1-\gamma} \right]^{\alpha} CXP_i^{1-\alpha} \quad \textit{export prices equation} \quad (2)$$

$$M_i = (Y_i, MCOM) \Rightarrow M_i = (Y_i, \frac{MMP_i}{P_i / N_i}) \quad \textit{import volume equation} \quad (3)$$

$$MP_i = \left[\left(\sum_{j \neq i} v_{ij} MXP_j \right)^{\phi} (P_i / N_i)^{1-\phi} \right]^{\beta} CMP_i^{1-\beta} \quad \textit{import prices equation} \quad (4)$$

where $XCOM$, MXP and CXP denote export competitiveness, manufacturing export prices and commodity export prices; $MCOM$, MMP and CMP are corresponding import variables; Y, P and N are real output, domestic output price and nominal exchange rate (domestic currency per US dollar); α, β, ϕ and γ are parameters. i denotes individual country and j denotes all the other countries except country i. $\sum_{i \neq j} M_j$ denotes total demand of import volume by other blocs. $\sum_{j \neq i} h_{ij} MXP_j$ and $\sum_{j \neq i} v_{ij} MXP_j$ are the world manufacturing export and import prices respectively, measured as the weighted average of other countries' manufacturing export prices. The weights h_{ij} and v_{ij} are derived from manufacturing trade data.

In Wren-Lewis' (2004a), trade for China is separated into manufacturing (differentiated) goods and commodities (identical goods) for year 2002. In our study, given the relatively long sample period (1960-2005), data of manufacturing goods are limited not only for China, but also for some other countries. Hence the trade volume and trade prices equations will be modelled at an aggregate level as in Barisone *et al* (2006). Therefore, equations (1)-(4) can be rewritten as

$$X_i = (\sum_{i \neq j} M_j, XCOM_i) \Rightarrow X_i = (\sum_{i \neq j} M_j, \frac{\sum_{j \neq i} h_{ij} XP_j}{XP_i}) \quad \textit{export volume equation} \quad (5)$$

$$XP_i = \left[\left(\sum_{j \neq i} h_{ij} XP_j \right)^{\gamma} (P_i / N_i)^{1-\gamma} \right]^{\alpha} CXP_i^{1-\alpha} \qquad \textit{export prices equation} \qquad (6)$$

$$M_i = (Y_i, MCOM) \Rightarrow M_i = (Y_i, \frac{MP_i}{P_i / N_i})_i \qquad \textit{import volume equation} \quad (7)$$

$$MP_i = \left[\left(\sum_{j \neq i} v_{ij} XP_j \right)^{\phi} (P_i / N_i)^{1-\phi} \right]^{\beta} CMP_i^{1-\beta} \qquad \textit{import prices equation} \qquad (8)$$

$$NT_i = X_i (\sum_{i \neq j} M_j, \frac{XP_i}{\sum_{j \neq i} h_{ij} XP_j}) XP_i \left\{ \left[\left(\sum_{j \neq i} h_{ij} XP_j \right)^{\gamma} (P_i / N_i)^{1-\gamma} \right]^{\alpha} CXP_i^{1-\alpha} \right\}$$

$$- M_i (Y_i, \frac{MP_i}{P_i / N_i})_i MP_i \left\{ \left[\left(\sum_{j \neq i} v_{ij} XP_j \right)^{\phi} (P_i / N_i)^{1-\phi} \right]^{\beta} CMP_i^{1-\beta} \right\} \qquad (9)$$

where NT denotes the net trade; i denotes China and j denotes China's 11 main trade partners. Hence N denotes the nominal exchange rate of the Chinese Yuan against the US Dollar (CNY/USD). An increase (decrease) in N indicates a depreciation (appreciation) of the RMB.

Using the estimated coefficients in equations (5)-(8) and actual values of the variables, we can calculate the predicted trade balance that is stripped out of temporary shocks.

To obtain the trend trade balance, the internal balance condition (zero output gap) must be satisfied. Hence we replace the actual output by its trend value. The trend trade balance at this stage does not yet allow for the trend effect of China's main trade partners on China. The final stage is to allow for such trend effect. To do so, HP (Hodrick-Prescott)-filtered rather than actual import volume and export prices of other countries are used. The trend trade balance at this stage allows for the trend effect, hence becomes the full trend trade balance.

2.1.2. Trend Current Account

Following You and Sarantis (2009a) and Barisone *et al* (2006), we regard IPD flows as exogenous while taking into account the effect of exchange rate revaluation and smoothing the series using the HP-filter. The smoothed IPD flows, $\overline{IPD}$, are given by

$$\overline{IPD} = \left(1 + \frac{FEER - N}{N}\right)\overline{(IPDC - IPDD)} \tag{10}$$

where $\frac{FEER - N}{N}$ is the revaluation effect measured in nominal terms[4], and $IPDC$ and $IPDD$ denote, respectively, overseas assets held by domestic residents and domestic assets held by overseas residents.

The last component of trend current account is the trend net transfer. Following You and Sarantis (2009a) and Barisone *et al* (2006), we regard the net transfer as exogenous and obtain the trend net transfer using the HP-filter. Therefore, the trend current account for China is the sum of full trend net trade, trend IPD flows and trend net transfer.

[4] Wren-Lewis (2003) relates the rate of IPD return of each bloc to a "synthetic world IPD return" and evaluates the value of overseas assets using weights based on the proportion of different currencies in

2.2. Sustainable Current Account

For the purpose of estimating the equilibrium nominal bilateral exchange rate of CNY against the USD, we will only model the sustainable current for China. Existing applications of FABEER model (Wren-Lewis, 2003, 2004a, b) employ off-model projections of sustainable current account. In particular, Wren-Lewis (2004b) assumes the sustainable current account for China in 2002 to be 1% or 0% of GDP. As discussed in Section 1, this could be misleading when considering a longer period, since the determinants of the current account evolve over time.

Therefore, we adopt the same approach used in You and Sarantis (2008a, 2009a) and model the sustainable current account as savings minus investment. This introduces a number of fundamentals into the model that reflect the unique characteristics of the Chinese economy and have not been employed by previous studies on China's current account or the exchange rate. However, the relative variables between China and the US are now replaced by effective variables that reflect the relative fundamentals between China and its 11 main trade partners. These effective variables include effective unit labour cost and effective interest rate[5]. Therefore, the sustainable current account is determined by

$$CAY = S - I = CAY(Z) \tag{11}$$

$$\text{where } Z = (\underset{+}{TFP}, \underset{-}{CREP}, \underset{-}{DEP}, \underset{+}{ERULC}, \underset{-}{RRC}, \underset{+}{FR}, \underset{+}{B}, \underset{+}{TAX}, \underset{-}{GI},) \tag{11a}$$

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total assets for each individual bloc. For China, we use equation (10) as data on IPD return (or interest rate) and composition of different currencies in assets is not available.

[5] The methodology used for the construction of effective variables is explained in You and Sarantis (2008c). We would like to construct effective variables for all fundamentals, and not just for the unit labour cost and the interest rate. Unfortunately we have been unable to obtain consistent time series on the other fundamentals for most of China's trade partners, so for these fundamentals we will only use the Chinese variables.

where TFP, $CREP$, DEP, $ERULC$, RRC, FR, B, TAX and GI denote, respectively, total factor productivity, financial liberalisation, dependency ratio, effective unit labour cost, relative rate of return to capital, effective interest rate, relative real price of capital, taxation rate and government investment. The signs under fundamentals indicate their effects on the sustainable current account (see You and Sarantis (2009a) for an explanation of these signs).

3. Empirical Results

The measurement of variables and data sources are explained in the Appendix. The sample period is 1960-2005. We use the Johansen cointegration method to test for long-run equilibrium relationships. Before carrying out the cointegration tests, we test for the stationarity of the variables using the augmented Dickey-Fuller (ADF) unit root test with the lag length chosen by the general to specific procedure suggested by Campbell and Perron (1991). We set a maximum lag length of 3 and then we tested down using a 10% level of significance. As discussed by Campbell and Perron (1991) and Ng and Perron (1995), this method has better size and power properties compared with alternative methods, such as selecting the lag length based on the Akaike Information Criterion (AIC).

Based on the estimated unit root statistics in Table 2, the ADF test cannot reject the null of a unit root for all variables either at 1% or 5% significance levels. Hence all variable are regarded as nonstationary. ADF tests for the first difference of the nonstationary variables show that all of them are $I(1)$ processes. Hence all variables can enter into a cointegration relationship. The ADF statistics with lags chosen by the AIC criterion confirm the results obtained by the general to specific method.

3.1. Full Trend Net Trade Balance

In this section we report the Johansen cointegration estimates for the four trade equations for China. A constant and a time trend are incorporated in equations (5)-(8)[6]. A dummy for 1985 is also introduced in the export volume equation[7]. In the case of the trade prices equations, freely estimated coefficients of the commodity prices for the whole sample period were implausibly high or low. Hence we had to impose the coefficients[8]. We fixed the coefficients on the commodity prices to the average commodity composition of China's trade between 1980-2005, which are 0.24 and 0.20 in export and import prices equations respectively.

For the export prices equation, we introduced a dummy for 1972[9] to capture the change in the exchange rate regime, and it yielded significant results. In the case of the import prices equation, there is no significant cointegrating vector when we estimate it for the whole sample period, with or without trend and/or dummy. Hence, we decided to exclude the turbulent 1960s. We did obtain a significant cointegrating vector for the sample period 1970-2005 but the coefficients were rather implausible. Hence we decided to impose the coefficients. Given the estimates of trade price equations in You and Sarantis (2009a), the coefficients of WXPCNv and PCN are imposed to be 0.65 and 0.15 respectively.

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[6] When equations (5)-(8) were estimated without including constants, trends and/or dummies, most of the coefficients in the trade equations were either implausible or statistically insignificant. Therefore, apart from constants, we also considered trends. Some dummies were also introduced to capture the effect of government policies on foreign trade. Note that Wren-Lewis (2004a, b) also incorporates trends in the trade equations.

[7] On 1st of Jan 1985 the "Dual Exchange Rate System" was abolished by the Chinese government. Therefore, we introduced a dummy for 1985 into the export volume equation to evaluate the effect of this policy change. Since the "Dual Exchange Rate System" was originally designed to stimulate exports, we expect the dummy to be negatively signed.

[8] See Barisone *et al* (2006) for a similar approach.

[9], The nominal exchange rate of CNY against the USD was fixed during the period 1960-1971, adjustable between 1972-1993, and fixed since 1994. The changes in the exchange rate policy, mainly from fixed to adjustment and fixed again, may have had some impact on the export prices. Therefore we incorporated dummies for 1972 and 1994, but only the former turned out to be significant. It implies that the adjustment of the nominal exchange rate, mainly depreciation against the USD, had a negative effect on (reduces) the export prices that are measured in USD.

To determine the lag length of the VAR, we started with maximum lag of 3 and tested downwards using the AIC criterion. For all trade equations, VAR (1, 2) was chosen. The results of the estimations of the four trade equations are shown in Table 3. The max-eigenvalue statistic suggests only one CV at 5% significance level for all four trade equations while the trace statistic suggests only one CV at 5% for import volume equations and more than one CVs for all others. We chose the results based on the max-eigenvalue statistic as Banerjee *et al* (1986, 1993) suggest that the max-eigenvalue statistic is more reliable in small samples. Therefore, there is one significant cointegrating vector for all four trade equations. The adjustment factors for these trade equations are all negative and significant at 1% (except at 5% for import prices equation), implying that all trade equations are stable in the long-run. All estimated coefficients are correctly signed and statistically significant at 5% (except coefficient of domestic price (PCN) in export prices equation at 10%). The coefficients are further summarised in Table 4.

In the export volume equation, export competitiveness (XCOMCN) and the sum of total imports of China's main trade partners (WTCN) have coefficients of 2.02 and 0.87 respectively. This implies that China's exports are more responsive to changes in relative prices than to changes in foreign demand. On the other hand, import competitiveness (MCOMCN) and real domestic demand (YCN) have coefficients of -0.30 and 0.61 respectively, suggesting that domestic demand (income) is more important than the relative price in determining China's demand for imports. The (absolute) sum of export and import price elasticities is 2.32. This is considerably greater than unity and implies that the Marshall-Lerner condition is satisfied for China, due primarily to the high export prices elasticity. Therefore, devaluation (appreciation) of the RMB can have a positive (negative) effect on China's trade balance. The dummy for 1985 has the expected negative sign and is highly significant, which implies that the abolition of the dual exchange rate system at the beginning of 1985 had a negative effect on China's exports.

In the export prices equation, the weighted export prices of China's main trade partners (WXPCNh) has a coefficient of 0.67 and the domestic price (PCN) has a coefficient of 0.09. This implies that 88% of China's export prices is determined by the former and 12%[10] by the latter respectively. The dummy for 1972 has the expected negative sign, suggesting the adjustment of the nominal exchange rate had a negative effect on export prices. The estimates suggest that China's import prices are also determined primarily by world trade prices.

Based on the coefficients in Table 3 and the actual values of variables, we obtain the predicted trade volumes and prices and hence the predicted exports and imports, which are depicted in Figures 1 and 2. Then we impose the internal balance condition to derive the trend net trade of China. However, such trend net trade does not allow for the trend effect of China's main trade partners on China. Therefore, the final step is to allow for such effect by applying the smoothed import volume and export prices of China's trade partners into the trend net trade. Thus we obtain the full trend net trade. These three series are plotted against the actual net trade in Figure 3.

As Figure 1 illustrates, predicted and actual exports followed each other quite closely with the former higher than the latter before 1985. The reverse was observed after 1985. A similar pattern emerges for predicted and actual imports (Figure 2), though the deviations were slightly wider. The predicted and trend net trade (Figure 3) were very close (almost overlapping). The predicted, trend and full trend net trade were close to the actual net trade before the early 1980s. Since the mid-1980s, they were

[10] 88%=0.67/(0.67+0.09)*100%; 12%=0.09/(0.67+0.09)*100%.

higher than the actual net trade for most of the years, especially after the end of the1990s.

3.2. Trend Current Account

The trend current account is the sum of the full trend net trade, trend IPD flows and trend net trade. The trend current account is shown against the actual current account, both measured as a percentage of GDP, in Figure 4. The trend current account stayed below the actual current account until 1982. The opposite pattern is observed for most years during the post-reform period, with the trend current account rising dramatically and much faster than the actual current account especially since 1999. During the rest of the period the two series were quite close apart from a comparatively large divergence in the mid-1980s.

3.3. Sustainable Current Account

The sustainable current account (equation (11)) is a long-run equilibrium relationship and is estimated with the Johansen cointegration method. Due to the large number of fundamentals, we adopted the same strategy as in You and Sarantis (2008c), i.e. keeping the core variables (total factor productivity, dependency ratio, financial liberalisation) in all equations and dropping the ones that are not significant. To determine the optimum lag order of the VAR, we started with a maximum lag of 3 and tested downwards using the AIC criterion. For all experiments, VAR (1, 1) was chosen. To choose the number of cointegrating vectors (CVs), we rely on the max-eigenvalue statistic for reasons explained above. The results of the Johansen cointegration estimation are shown in Table 5.

The max-eigenvalue statistic suggests one CV at both 1% and 5% for equations E and F, and one CV at 5% for equation D. The adjustment factors are all negative and significant at 1% for equations D and F and at 10% for equation E, ensuring the long-run stability of the equations. All coefficients are significant at 5%, except RRC in equation D and GI in equation E which are not significant. In each equation, most of the fundamentals have the expected signs. In all three cases, the foreign real interest rate (FR) is wrongly signed and highly significant. Initially we calculated sustainable current account based on coefficients in all three equations D-F and HP-filtered fundamentals. However, the sustainable current account based on equation E was abnormally low (negative) in the 1960s and extremely large (positive) after the mid-1990s compared with the actual values. This may due to the extremely large and negative constant in equation E, which is rather unrealistic. In addition, the adjustment factor is significant only at 10%, compared with 1% in equations D and F. Sustainable current accounts based on equations D and F are quite close for the whole period. Since RRC in equation D is wrongly signed and insignificant, we decided to compute the sustainable current account based on the cointegrating vector F. The long-run equilibrium equation for the sustainable current account is

$$CAY = 1.5340TFP1 - 0.2620CREP - 0.2512DEP + 2.4545ERULC - 0.6453FR + 16.97 \qquad (12)$$

All coefficients are correctly signed (except FR) and significant at the 1% significance level. Based on the coefficients in equation (12) and HP-filtered fundamentals we obtain the sustainable current account measured as a percentage of GDP. It is referred to as SCAY. We plot SCAY against actual (CAY) and trend (TCAY) current accounts (all as a percentage of GDP) in Figure 4. We notice that SCAY turned from negative to positive in 1967 and remained positive thereafter. Furthermore, it was stable between 1967 and early 1990s, varying within 0-1.5%. Since early 1990s, SCAY had been increasing gradually from 1.5% to 6.1% in 2005. Compared with CAY, SCAY was much smoother, with CAY varying around it. Compared with the TCAY, SCAY remained above TCAY throughout the period 1965-1982. Since 1983, the TCAY had been higher than SCAY, except during 1995-1999. Such a relationship between the sustainable current account and the trend current account suggests that the RMB had been persistently overvalued from middle 1960s until 1982 and undervalued since 1983, except over the period 1995-1999.

4. The FEER and Misalignments

The trend current account is obtained by treating the nominal exchange rate as exogenous. Hence the nominal exchange rate must adjust to match the trend current account with the sustainable current account. Based on our trend and sustainable current account estimates, we solve for the equilibrium nominal exchange rate, or the nominal FEER (fundamental equilibrium exchange rate), that delivers such a match. The nominal FEER is plotted against the actual CNY/USD nominal exchange rate in Figure 5. The misalignment rates are exhibited in Figure 6. Abnormally large undervaluation occurred during 1960-1964, which is probably due to the disastrous "Great Leap Forward" campaign during that period. Hence, the years 1960-1964 are ignored in Figure 6 and we focus on the period 1965-2005. Table 6 summarises the findings on misalignment rates[11].

We divide the period 1965-2005 into four sub-periods: 1) 1965-1982, overvaluation; 2) 1983-1994, undervaluation; 3) 1995-1999, overvaluation, 4) 2000-2005, undervaluation. During the period 1965-1982, the nominal bilateral CNY/USD rate was below the FEER, which suggests the RMB was persistently overvalued against the USD with an average misalignment rate of 28%. Until 1978, there had been

[11] ADF tests show that the misalignment rates in Figures 6 are stationary at 5%.

overall nominal appreciation of the currencies of China's main trade partners (especially Japan) against the USD. The Chinese government also appreciated the value of RMB by decreasing the nominal exchange rate of CNY against the USD. However, unlike China's main trade partners, such appreciation of RMB was artificial and was not supported by economic fundamentals. The sustainable current account, which reflects the evolution of by economic fundamentals, suggests depreciation was needed rather than appreciation. The average overvaluation was 31% from 1965 to 1977, with the severest undervaluation of 44% occurring in 1968. During the early post-reform period 1978-1982, the USD appreciated against the currencies of China's main trade partners. The Chinese government accordingly depreciated the RMB from 1.8 CNY per USD in 1978 to 2.0 in 1982. Furthermore, developments in the fundamentals delivered a stable, but relatively lower, sustainable current account, thus posing less pressure on nominal depreciation. Hence, nominal overvaluation was reduced to an average of 20% in this early post-reform period.

During 1983-1985, the USD appreciated against the currencies of China's main trade partners (except Japan). Accordingly, the Chinese government depreciated the RMB from 2.0 CNY per USD to 2.9. Undervaluation during these three years may suggest that the pace of the artificial depreciation might had been too large and too fast. After 1986, the USD started depreciating against China's main trade partners (except the HK Dollar which was pegged to USD at 7.8HKD per USD since 1984) while the Chinese government further depreciated the RMB from 3.6 CNY per USD in 1986 to 8.6 in 1994. This led to further persistent undervaluation from 1986 to 1994, with the highest undervaluation of 30% in 1986. For the whole second period (1983-1994), the RMB was undervalued on average by 13%.

Over the period 1995-1999, the nominal USD appreciated against the currencies of China's main trade partners (except HKD) while the nominal exchange rate of CNY/USD was fixed at 8.3. Development in the economic fundamentals (as reflected in the sustainable and trend current accounts) also called for depreciation. These led to nominal overvaluation of the RMB at an average of 9% over this period.

During the most recent period 2000-2005, the nominal USD had been depreciating against the currencies of China's main trade partners (except HKD). Meanwhile, the nominal rate of CNY/USD was still fixed. The requirement for nominal appreciation of the RMB might have been more severe had the development of the economic fundamentals not brought the sustainable current account surplus to its highest levels in the whole sample period. The average misalignment rate for this period was 10%. The misalignment rates suggest an increasing tendency of undervaluation in this period. The highest misalignment occurred in the last four years with an average of 12% and a peack of 14% in 2003. We highlight the three current account series and misalignment rates since 2000 in Table 7.

We compare our findings with other studies assessing the equilibrium nominal bilateral exchange rate of China. By including China in the FABEER model of Wren-Lewis (2003), Wren-Lewis (2004a) estimated the equilibrium nominal CNY/USD rate for the single year 2002. Assuming a sustainable current account relative to GDP of either 1% or 0% , Wren-Lewis (2004a) finds an undervaluation of 20% or 28% respectively. These are more than twice as high as the one suggested by our study for the same year (11%). Given the differences between the two studies explained in Section 1, we are inclined to believe that our estimates for the trend and sustainable current accounts and, hence, the nominal FEER, are more reliable.

Based on the FEER model, Jeong and Mazier (2003) evaluate the equilibrium nominal CNY/USD rate for China for the period 1982-2000. The pattern of misalignments suggested by our findings is similar to that reported by Jeong and Mazier (2003) for most periods. The authors find undervaluation in most years from the early-1980s to early-1990s, overvaluation in the mid-1990s, and undervaluation since 1996. However, our findings suggest a much smaller magnitude of undervaluation than those by Jeong and Mazier (2003), especially from late 1990s afterwards. For instance, Jeong and Mazier (2003) suggest an undervaluation of 60% for the period 1997-2000, while in our study, not only the undervaluation starts three years later, but also the average undervaluation is 10% for the period 2000-2005 with the highest rate at 14% in 2003. Compared with Jeong and Mazier (2003), we include more of China's trade partners, estimate trade equations, and estimate the sustainable current account using economic fundamentals that reflect the unique features of the Chinese economy.[12] Hence our results are deemed to be more reliable.

We also compare our study with Funke and Rahn (2004), who examine the nominal bilateral equilibrium CNY/USD exchange rate for the period 1994-2002, but use the BEER model. The authors find overvaluation before 1997 and undervaluation thereafter, while our paper suggests that the undervaluation started two years later (in 1999). The magnitude of misalignment is also different. Funke and Rahn (2004) report undervaluation up to 17% , while our results indicate a rate of up to 14%.

[12] Jeong and Mazier (2003) include only Japan, South Korea, US and the Euro area, whilst we include 11 of China's trade partners. Furthermore, Jeong and Mazier (2003) calibrate rather than estimate coefficients in the trade equations. The authors use the savings-minus-investment norm following Debelle and Faruqee (1998) and Chinn and Prasad (2000). However, as emphasised in You and Sarantis (2009a), the fundamentals used in Debelle and Faruqee (1998) are not suitable for China.

5. Conclusions and Policy Implications

This paper presents for the first time an application of the extended FABEER model to China's nominal bilateral exchange rate of the CNY against the USD. It is also the first study of the equilibrium nominal CNY/USD exchange rate for both pre- reform and post-reform periods.

An important contribution of this paper is that we extend Wren-Lewis' (2003, 2004a) FABEER model in several important ways to make it applicable to China. First, we extend the 5-area model to include eleven of China's main trade partners which account for over 80% of China's foreign trade. Second, we model and estimate the sustainable current account. This allows us to incorporate into the sustainable current account fundamentals that reflect the unique features of the Chinese economy but have not been employed by other studies. Third, trade values are divided into volumes and prices, and then we estimate export and import volumes and prices equations separately. An additional contribution is the construction of a unique data set of consistent time series, which includes a wide range of economic fundamentals, Euro variables, and trade-related variables for China and its eleven trade partners since 1960. Such a data set allows us to carry out an econometric investigation of the trend and sustainable current accounts and, hence, of the equilibrium (FEER) nominal CNY/USD exchange rate, for both pre-reform and post-reform periods.

The following empirical findings warrant special mention. First, we found one cointegrating vector for each trade equation and for the sustainable current account equation, which supports the theoretical relationships in the FABEER model. Second, in the estimation of the trend current account we found that (a) increases in China's export volume are due mainly to improvements in its price competitiveness; (b) China's demand for imports is more income elastic than price elastic; (c) the

Marshall-Lerner condition holds in China; (d) China's export prices are mainly determined by the world trade prices.

Third, the estimates of the sustainable current account suggest that the significant fundamental determinants are total factor productivity, dependency ratio, financial liberalisation, effective relative unit labour cost and foreign interest rate. We found that the sustainable current account (measured as a percentage of GDP) was negative until 1966, positive and stable (within 1.5%) from 1967 until 1993, and has been increasing steadily since then, reaching 6.1% in 2005.

Fourth, comparison of the equilibrium (FEER) and actual nominal CNY/USD exchange rates shows persistent overvaluation of the nominal RMB against the USD from 1965 to 1982. The misalignment rates were considerably larger during the pre-reform period than those during the post-reform period. Over the period 1983-1994, when artificial depreciation of RMB was conducted by the government by raising the nominal exchange rate of CNY against the USD, there were 12 years of consecutive undervaluation with an average misalignment rate of 13%. During 1995-1999, when there was appreciation of the USD against the major currencies and the CNY was fixed against the USD, we found 5 years of consecutive overvaluation at an average rate of 9%. For the most recent and controversial period 2000-2005, we found persistent undervaluation in the nominal RMB against the USD, with an average misalignment rate of 10% and a peak of 14% in 2003. However, these misalignments are considerably smaller than those reported by previous studies.

The increasing trend in the magnitude of undervaluation since the beginning of the new millennium raises the question weather China should switch immediately to a floating exchange rate, or increase gradually the flexibility of the exchange rate system and adopt the floating exchange rate system ultimately. There seems to be consensus amongst most researchers that a sudden switch to a floating exchange rate will not be feasible for China given its underdeveloped financial market and a gradual or step by step approach is more appropriate (i.e. McKinnon, 2003; Goldstein, 2004; Frankel, 2006; Cappiello and Ferrucci, 2008).

Our empirical findings also support this view. Although the RMB has been undervalued, the misalignments have been relatively modest compared to those suggested by most previous studies. On the basis of these misalignments, the immense political pressure from the US demanding sizeable revaluation of the RMB is unwarranted. Such an argument is confirmed by Frankel and Wei (2007), whose econometrical estimations suggest that the US Treasury's verdict that "China is guilty of manipulating its currency to gain competitiveness" is largely driven by political variables. If the undervaluation, as implied by the economic fundamentals, is relatively modest, but the political pressure from the US demanding sizeable revaluation is very strong, there is a serious risk that once the exchange rate is floated, enormous speculations fueled by the political pressure will push the RMB not just closer to its equilibrium value, but also to excessive overvaluation.

Furthermore, given that China's financial markets are still underdeveloped, it will not be able to cope with an abruptly floating exchange rate system followed by enormous international speculation. Instead, what is called for, is greater flexibility in the nominal exchange rate in the short term, with gradual adjustment towards a floating system over the medium to long term. Greater flexibility in the nominal exchange rate requires the adoption of broader floating bands not only for the CNY/USD rate[13], but also for the exchange rate of the CNY against the currencies of China's other main trade partners (e.g. Euro, Korean Won, Yen, etc). In addition, there should be a gradual increase in the weights of other currencies that are included in the basket of currencies used by the China's Central Bank (which is currently dominated by the USD)[14], to reflect the increasing importance of other countries for China's foreign trade.

[13] This increased in March 2007 from ±0.3% to ±0.5% daily. However this is rather limited; a much broader floating band is required for greater nominal exchange rate flexibility.
[14] Eichengreen (2006) and Frankel and Wei (2007) estimate that the US dollar has a weight of approximately 90% in the basket of currencies used by China's Central Bank.

Appendix. Data Sources and Variable Measurement

The main data sources of this study include the *50 Years of New China* (*50YNC*), *China Statistical Yearbook* (*CSY 2006)* of China National Statistical Bureau (NBS), *International Financial Statistics* (*IFS*), *Eurostat*, *Direction of Trade Statistic*s (*DOTs*), and the *United Nations Conference on Trade and Development* (*UNCTAD*). The sample period is 1960-2005. All indices have 2000 as the base year (2000=100), unless otherwise stated.

Economic blocs included in the extended FABEER model are: China, Euro area (which consists of 12 Euro countries), Australia, Canada, Hong Kong (China), Japan, Korea, Malaysia, Singapore, Thailand, United States and the United Kingdom. We refer to them as China, Euro area and the 10 blocs.

Euro variables: As data for the Euro area are not available until late 1990s, synthetic Euro area time series are needed for the earlier years. Following Maeso-Fernandez *et al* (2001), synthetic Euro area time series (X_t^{EURO}) are measured as the geometrically weighted average of the individual Euro area country time series, with the weight y_k for each Euro area country (k) equal to the ratio of manufacturing trade of this Euro area country to the total manufacturing trade of the whole Euro area,

$$X_t^{EURO} = \prod_{k=1}^{12} \left(X_t^k \right)^{y_k} \tag{13}$$

where k = the 12 Euro countries: Austria, Belgium, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain and the weights attached to each countries (y_k) are collected from Maeso-Fernandez *et al* (2001)[15]: Austria, 2.89; Belgium-Luxembourg, 7.89; Finland, 3.27; Germany, 34.49, Greece, 0.736; Ireland, 3.76; Italy, 13.99; Netherlands, 9.16; Portugal, 1.07; Spain, 4.90.

Synthetic Euro time series were constructed for the import and export prices. The earliest year from which data for Euro area import and export prices ares available, is 1995. The data are provided by *Eurostat*. After constructing synthetic Euro area import and export prices for 1960-1997, we choose 3 overlapping years (1995- 1997). We divide the sum of Euro area import and export prices of these three years collected from *Eurostat* by the sum of our constructed synthetic Euro area import and export prices of the same three years to generate the adjustment factors. The synthetic Euro area import and export prices for the period 1960-1994 are multiplied by the adjustment factors to make them consistent with those for 1995-2005. Other time series of the Euro area include import and export values (in USD) which are calculated as the sum of the 12 Euro countries. Data for import and export values for each individual Euro country are collected from *DOTs*.

Export Values and Import Values: DOTs provide each individual country's (including China, the 10 blocs and the 12 Euro countries) trade flow (in USD) with every other country in the model.

Export Prices and Import Prices: the measurement of export prices ($XPCN$) and import prices ($MPCN$) of China (in USD) is discussed in You and Sarantis (2008c). Data for export and import prices (in USD) (2000=100) for the 10 blocs and 12 Euro countries are collected from *IFS* (lines 76.ZF and 76.X.ZF)[16]. Data for the Euro area are explained above.

Import Volumes: First we add up each individual country's imports from each other country in the model to obtain each country's total import value. For instance, China's total import value equals the sum of China's import from the Euro area and the 10

[15] These weights have been used in other studies (i.e. Schnatz and Osbat, 2003)

[16] When export and import prices (lines 76.ZF and 76.X.ZF) are not available, unit export and import values from *IFS* are used (lines 74.ZF and 75.ZF).

blocs. Then by dividing import value (in USD) by the import prices index and multiplying by 100, we obtain the imports at constant prices for China (MCN), the 10 blocs, and the Euro area.

Export Volume for China (XCN): By dividing China's export values (in USD) by the export prices index and multiplying by 100, we obtain exports at constant prices for China (MCN).

Nominal CNY/USD Exchange Rate (N): Nominal CNY/USD rate is collected from *IFS* (line 924.RF.ZF). It is then converted into an index.

GDP Price Deflator (PCN) and Real GDP (YCN) for China: The measurement of these variables is explained in You and Sarantis (2008c). However, in this paper the two series are converted into USD by using the nominal exchange rate, *N*.

Export Competitiveness of China ($XCOMCN$): This is defined as the world export prices in export equation ($\sum_{j \neq i} h_{ij} XP_j$), which is discussed below, divided by China's export prices.

Import Competitiveness of China ($MCOMCN$): This is defined as domestic import prices (in USD) divided by the domestic GDP price deflator (in USD).

World Export Prices in Export Prices Equation of China ($\sum_{j \neq i} h_{ij} XP_j = WXPCNh$): This is measured as a weighted average of export prices of all countries in the model (except country i), with the weights h_{ij} equal the exports of country j divided by exports of all countries in the model (except country i, where i=China).

World Export Prices in Import Prices Equation of China ($\sum_{j \neq i} v_{ij} XP_j = WXPCNv$): This is measured as a weighted average of export prices of all countries in the model (except country i), with the weights v_{ij} equal the ratio of country i's imports from country j to country i's total imports (in our model, i=China).

World Import Volume in Export Volume Equation of China ($\sum_{i \neq j} M_j = WTCN$): This is measured as the sum of imports at constant prices of all countries in the model (except country i). Hence world import volume for China equals the sum of imports at constant price of its main trade partners (Euro area and the 10 blocs).

Commodity Export ($CXPCN$) *and Commodity Import* ($CMPCN$) *Prices of China*: The measurement of commodity export and import prices is explained in You and Sarantis (2009a, Appendix B). However, they are both converted into USD in this paper, using the nominal exchange rate, *N*.

Real Current Account: The measurement of this variable is explained in You and Sarantis 2009a, Appendix B). But in this paper the series is converted into USD by using the nominal exchange rate, *N*.

Chinese Economic Fundamentals $(TFP, CREP, DEP, ERULC, RRC, FR, B, TAX, GI)$: See You and Sarantis (2008c) for a detailed description of the measurement of these variables. The only difference is that You and Sarantis (2008c) include 4 Euro countries in the construction of the effective variables *ERULC* and *FR*, while in this study we include 12 Euro countries.

Total Factor Productivity (*TFP*)*:* This is calculated in You and Sarantis (2008b) from the estimation of a production function that includes for the first time rural transformation. Note that *TFP1* and *TFP2* are based on two alternative measures of capital stock: (a) *K1* that is calculated by employing the methodology of Chow and Li (2002), but using updated data from CSY 2006 and extended from 1998 to 2005; (b) *K2* obtained from Bai *et al* (2006).

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Table 1. History of China's Foreign Exchange Policy

Year	Historical Events of China's Foreign Exchange Policy
1956-1978	The nominal exchange rate of CNY against the USD was fixed until 1971. The government appreciated moderately the RMB during 1972-1978. Apart from this there were almost no adjustments on the foreign exchange policy.
1979	Foreign Exchange Rate Retention System was introduced.
October 1980	Bank of China started to take foreign exchange retention as one of its services.
1981	Internal Rate of Trade Settlement was introduced.
1985	Internal Rate of Trade Settlement was terminated. It was the first unification between the internal and official rates in China's foreign exchange policy history.
March 1988	Local Foreign Exchange Adjustment Centres were established one after another, where the official exchange rate was substituted by the swap rates agreed by two parties. The Dual Exchange Rate System was formed.
1985-1990	The foreign exchange rate of CNY against the USD was adjusted frequently in large scales.
1991-1993	The foreign exchange rate of CNY against the USD was adjusted gradually and less frequently.
1994	The Dual Exchange Rate System was terminated. It was the second unification between the swap and official rates in China's foreign exchange policy history. The conditional convertibility under current account was accomplished.
December 1996	The unconditional convertibility under current account was accomplished. China announced meeting the requirements of Article VIII of the Agreement of International Monetary Fund (IMF).
December 1998	All Foreign Exchange Adjustment Centres were closed.
July 2005	Chinese central bank announced a 2% revaluation of CNY against USD. The RMB is pegged to a basket of currencies rather just the USD. The floating band of the CNY against the USD is daily ±0.3% while that of the CNY against other currencies has remained under the discretion of the central bank.
May 2007	Chinese central bank increased the floating band of the CNY against the USD from daily ±0.3% to ±0.5% while that of the CNY against other currencies has remained under the discretion of the central bank.

Table 2. Unit Root Tests (ADF)

	General to Specific					AIC				
Sample Period: 1960-2005		Level		1st Difference			Level		1st Difference	
Variables	Lag Length	ADF	p-value	ADF	p-value	Lag Length	ADF	p-value	ADF	p-value
XCN	3	1.38	0.9986	-3.91	0.0044	3	1.38	0.9986	-3.91	0.0044
WTCN	1	-0.82	0.8030	-4.33	0.0013	2	-0.70	0.8359	-3.67	0.0082
XCOMCN	0	-1.41	0.5689	-7.05	0.0000	1	-2.22	0.2033	-4.68	0.0005
MCN	2	0.79	0.9927	-5.03	0.0002	2	0.79	0.9927	-5.03	0.0002
YCN	2	1.17	0.9975	-6.14	0.0000	2	1.17	0.9975	-6.14	0.0000
MCOMCN	0	-1.06	0.7226	-6.01	0.0000	0	-1.06	0.7226	-6.01	0.0000
XPCN	3	-1.97	0.2976	-3.20	0.0271	3	-1.97	0.2976	-3.20	0.0271
WXPCNh	1	-1.88	0.3405	-3.63	0.0090	1	-1.88	0.3405	-3.63	0.0090
PCN	0	-1.80	0.3745	-5.63	0.0000	1	-1.91	0.3236	-5.63	0.0000
CXPCN	2	-1.23	0.6513	-3.41	0.0163	2	-1.23	0.6513	-3.41	0.0163
MPCN	1	-1.43	0.5575	-3.71	0.0073	1	-1.43	0.5575	-3.71	0.0073
WXPCNv	0	1.68	0.9759	-5.47	0.0000	1	1.60	0.9715	-4.12	0.0001
CMPCN	2	-1.39	0.5805	-3.56	0.0110	2	-1.39	0.5805	-3.56	0.0110
CAY	0	-2.26	0.1877	-6.44	0.0000	0	-2.26	0.1877	-6.44	0.0000
TFP1	2	0.44	0.9827	-5.22	0.0001	3	0.86	0.9941	-3.94	0.0037
TFP2	2	0.99	0.9959	-4.60	0.0005	2	0.99	0.9959	-4.60	0.0005
DEP	1	0.82	0.9932	-3.09	0.0351	1	0.82	0.9932	-3.09	0.0351
CREP	1	-0.74	0.8262	-4.32	0.0013	1	-0.74	0.8262	-4.32	0.0013
ERULC	0	-1.36	0.5925	-7.03	0.0000	0	-1.36	0.5925	-7.03	0.0000
FR	0	-2.34	0.1634	-6.75	0.0000	0	-2.34	0.1634	-6.75	0.0000
RRC	0	-2.73	0.0774	-7.58	0.0000	0	-2.73	0.0774	-7.58	0.0000
B	1	-1.32	0.6105	-4.07	0.0027	1	-1.32	0.6105	-4.07	0.0027
TAX	0	-2.25	0.1923	-6.40	0.0000	0	-2.25	0.1923	-6.40	0.0000
GI	1	-0.61	0.8587	-4.24	0.0016	3	-0.59	0.8628	-2.78	0.0691

Note: Critical values for 1%, 5% and 10% are -3.57, -2.93 and -2.60 respectively.

X_i=XCN=China's export volume to its main trade partners; $\sum_{i \neq j} M_j$ =WTCN=total import volume of China's main trade partners; $XCOM_i$=XCOMCN=export competitiveness of China; M_i=MCN=China's import volume from its main trade partners; Y_i=YCN=real output of China; $MCOM_i$=MCOMCN=import competitiveness of China; XP_i=XPCN=export prices index of China; $\sum_{j \neq i} h_{ij} XP_j$ =WXPCNh=export prices of China's main trade partners in the export prices equation; P_i=PCN=domestic price index (GDP price deflator) of China; CXP_i=CXPCN=commodity export prices index of China; MP_i=MPCN=import prices index of China; $\sum_{j \neq i} v_{ij} XP_j$ =WXPCNv=export prices of China's main trade partner in the import prices equation; CMP_i=CMPCN=commodity import prices of China; CAY=real current account/GDP ratio; TFP1=total factor productivity 1; TFP2=total factor productivity 2; DEP=dependency ratio; CREP=financial liberalisation; ERULC=effective relative unit labour cost; FR= foreign interest rate; RRC=relative return to capital (between China and the USA); B=relative price of capital to output; TAX=tax rate; GI=government investment/total investment ratio.

All variables are measured in natural logarithm except FR and RRC as they are rates of returns. Also CAY is not measured in natural logarithm as it contains negative values.

Table 3. Johansen Cointegration Results: Trade Volumes and Prices Equations

	Hypothesized No. of CE(s)	Trace Statistic	5% Critical Value	1% Critical Value	p-value	Max-Eigen Statistic	5 % Critical Value	1% Critical Value	p-value
Export Volume Equation	None	98.81*	69.82	77.82	0.0001	34.47*	33.88	39.37	0.0156
	At most 1	60.89*	47.86	54.68	0.0019	12.04	27.58	32.72	0.0524
Import Volume Equation	None	61.15*	47.86	54.68	0.0018	32.19*	27.58	32.72	0.0122
	At most 1	29.05	29.80	34.46	0.0608	16.50	21.13	25.86	0.1968
Export Prices Equation	None	89.17*	69.82	77.82	0.0007	41.05*	33.88	39.37	0.0059
	At most 1	48.11*	47.86	54.68	0.0047	24.67	27.58	32.72	0.1128
Import Prices Equation	None	93.03*	69.82	77.82	0.0003	40.44*	33.88	39.37	0.0071
	At most 1	52.59*	47.86	54.68	0.0168	21.16	27.58	32.72	0.2667

Normalized cointegrating coefficients (std.err. in parentheses)

Export Volume Equation	XCN	WTCN	XCOMCN	T	D85	C
	1.0000	-0.8718	-2.0195	-0.0905	0.2277	12.1559
		(0.0719)	(0.2259)	(0.0057)	(0.0883)	
	Adjustment coefficient (std.err. in parentheses)					
	D(XCN)	-0.6058				
		(0.1416)				
Import Volume Equation	MCN	YCN	MCOMCN	T	C	
	1.0000	-0.6067	0.2996	-0.0839	-1.8274	
		(0.1824)	(0.1366)	(0.0175)		
	Adjustment coefficients (std.err. in parentheses)					
	D(MCN)	-0.5580				
		(0.1462)				
Export Prices Equation	XPCN	WXPCNh	PCN	CXPCN	D72	C
	1.0000	-0.6663	-0.0937	-0.2400	0.1322	-0.1168
		(0.0525)	(0.0525)	(0.0000)	(0.0521)	
	Adjustment coefficients (std.err. in parentheses)					
	D(XPCN)	-0.4801				
		(0.1612)				
Import Prices Equation	MPCN	WXPCNv	PCN	CMPCN	T	C
	1.0000	-0.6500	-0.1500	-0.2000	-0.0020	0.3194
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	
	Adjustment coefficients (std.err. in parentheses)					
	D(RMP)	-0.1919				
		(0.0866)				

Note: "*" denotes rejection of the hypothesis at the 5% level. Critical values are taken from MacKinnon *et al* (1999).

Table 4. Estimated Coefficients in the Trade Volumes and Prices Equations

Export Volume (XCN)				Import Volume (MCN)		
Trade Partners' Activity (WTCN)	Competitiveness (XCOMCN)	Trend (T)	Dummy (D85)	Domestic Activity (YCN)	Competitiveness (MCOMCN)	Trend (T)
0.87	2.02	0.090	-0.23	0.61	-0.30	0.084

Export prices (XPCN)				Import prices (MPCN)			
Trade Partners (WXPCNh)	Domestic (PCN)	Commodity (CXPCN)	Dummy (D72)	Trade Partners (WXPCNv)	Domestic (PCN)	Commodity (CMPCN)	Trend (T)
0.67	0.09	0.24^F	-0.13	0.65^F	0.15^F	0.20^F	0.002^F

Note: Superscript "F" denotes the parameters are fixed.

Table 5. Johansen Cointegration Results: Sustainable Current Account[17]

	Hypothesized No. of CE(s)	Trace Statistic	5 % Critical Value	1% Critical Value	p-value	Max-Eigen Statistic	5% Critical Value	1% Critical Value	p-value
Equation D	None	157.66*	125.62	135.97	0.0001	50.07*	46.23	52.31	0.0185
	At most 1	107.58*	95.75	104.96	0.0060	39.71	40.08	45.87	0.0549
Equation E	None	248.41*	197.37	210.05	0.0000	71.40*	58.43	65.00	0.0017
	At most 1	177.02*	159.53	171.09	0.0039	47.33	52.36	58.67	0.1496
Equation F	None	121.36*	97.75	104.96	0.0003	53.96*	40.08	45.87	0.0008
	At most 1	67.40	69.82	77.82	0.0768	28.30	33.88	39.37	0.2000

Normalized cointegrating coefficients (std.err. in parentheses)

Equation D	CAY	TFP1	CREP	DEP	ERULC	RRC	FR	C		
	1.0000	-1.6292	0.2706	0.1999	-2.0010	-0.1199	0.5246	-13.8326		
		(0.4123)	(0.0466)	(0.0956)	(0.7477)	(0.1403)	(0.2022)			
	Adjustment coefficient (std.err. in parentheses)									
	D(CAY)	-0.2650								
		(0.1041)								
Equation E	CAY	TFP1	CREP	DEP	ERULC	B	FR	GI	TAX	C
	1.0000	-1.7398	0.4302	0.3740	-2.2968	0.2481	0.8649	-0.0694	-0.4636	-57.6595
		(0.4709)	(0.0465)	(0.1452)	(1.0585)	(0.0896)	(0.2490)	(0.0578)	(0.1705)	
	Adjustment coefficient (std.err. in parentheses)									
	D(CAY)	-0.1413								
		(0.0809)								
Equation F	CAY	TFP1	CREP	DEP	ERULC	FR	C			
	1.0000	-1.5340	0.2620	0.2512	-2.4945	0.6453	-16.9701			
		(0.3757)	(0.0405)	(0.0900)	(0.6650)	(0.1895)				
	Adjustment coefficient (std.err. in parentheses)									
	D(CAY)	-0.2816								
		(0.0935)								

Note: "*" denotes rejection of the hypothesis at the 5% level. Critical values are taken from MacKinnon *et al* (1999).

[17] When we used TFP2 instead of TFP1, we also found one cointegrating vector. However, when using TFP2, sustainable current turned out to be positive before middle 1980s and negative after that, which is the opposite of the actual current account and seems implausible. Therefore we only report cointegrating results based on TFP1.

Table 6. Summary of Findings: FEER for Nominal Bilateral CNY/USD Exchange Rate

<table>
<tr><td colspan="2">1965-1982
There were 18 years of consecutive overvaluation with an AMR of 28%</td><td colspan="3">1983-2005
Undervaluation occurred in 18 out of 23 years except 1995-1999.</td></tr>
<tr><td>1965-1977</td><td>1978-1982</td><td>1983-1994</td><td>1995-1999</td><td>2000-2005</td></tr>
<tr><td colspan="2">There was fixed nominal exchange rate until 1971 and small adjustments from 1972-1982.</td><td>(large depreciation of nominal exchange rate)</td><td>(Fixed nominal exchange rate)</td><td>(Fixed nominal exchange rate)</td></tr>
<tr><td>There were relatively large MRs in this period. AMR for this period is 31% with the peak MR at 44% in 1968.</td><td>In this early post-reform period MRs were relative smaller. AMR for this period was 20% with peak MR at 33% in 1980.</td><td>There were 12 years of consecutive undervaluation. AMR for this period was 13% with the peak MR at 30% in 1986.</td><td>There were 5 years of consecutive overvaluation. AMR for this period was 9% with the peak MR at 13% in 1996.</td><td>There were 6 years of consecutive undervaluation. AMR for this period was 10% with the peak MR at 14% in 2003.</td></tr>
</table>

Note: AMR and MR refer to average misalignment rate and misalignment rate respectively.

Table 7. Current Account and Misalignment Rates (%) in the Nominal CNY/USD Exchange Rate: 2000-2005

Year	2000	2001	2002	2003	2004	2005
CAY	1.7	1.3	2.5	2.8	3.6	7.2
TCAY	4.5	5.8	7.4	8.3	8.4	9.4
SCAY	3.2	3.7	4.2	4.8	5.6	6.3
Implied Misalignment (%)	-3.0	-5.4	-11.3	-13.6	-11.3	-12.8

Note: the minus sign implies undervaluation.

Figure 1. Predicted and Actual Exports (Million USD) (in Natural Log)

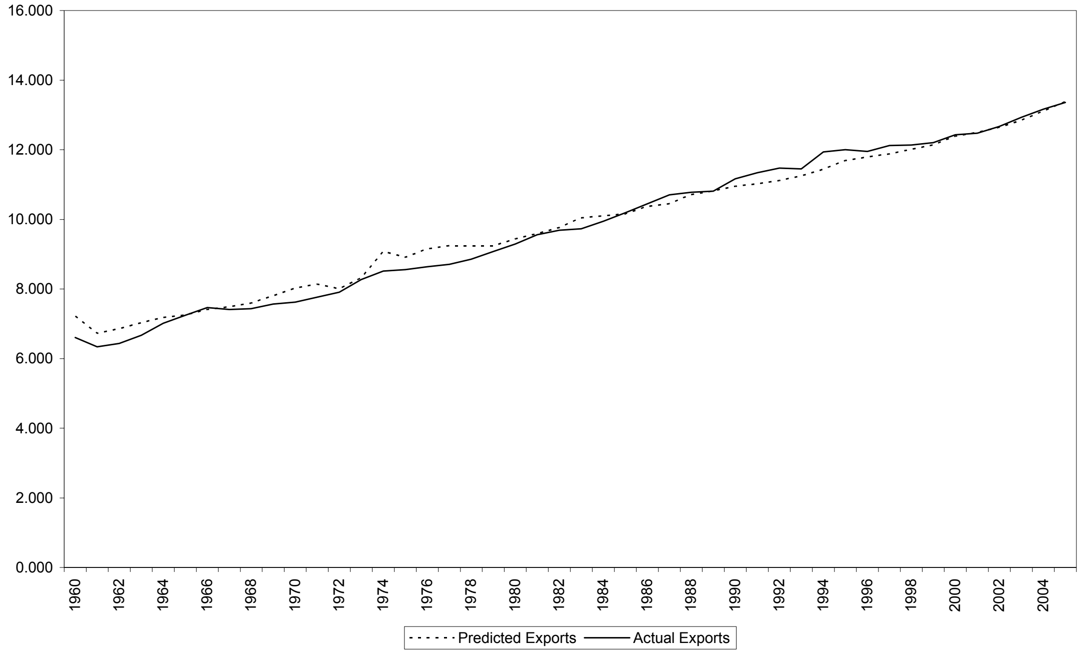


Figure 2. Predicted and Actual Imports (Million USD) (in Natural Log)

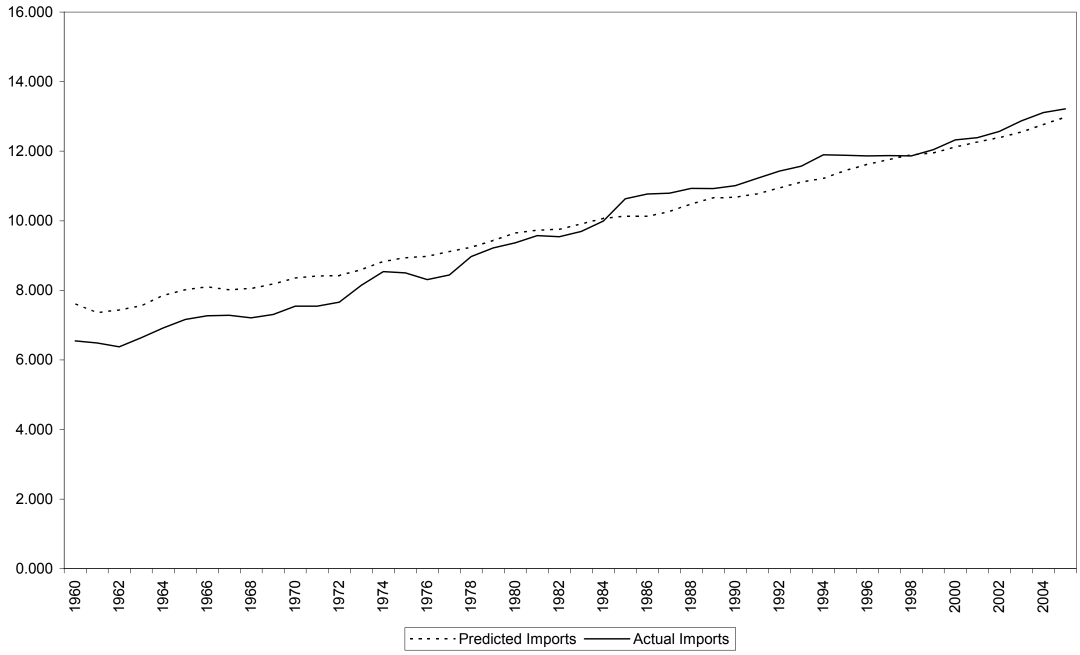


Figure 3. Predicted, Trend, Full Trend and Actual Net Trade (Million USD)

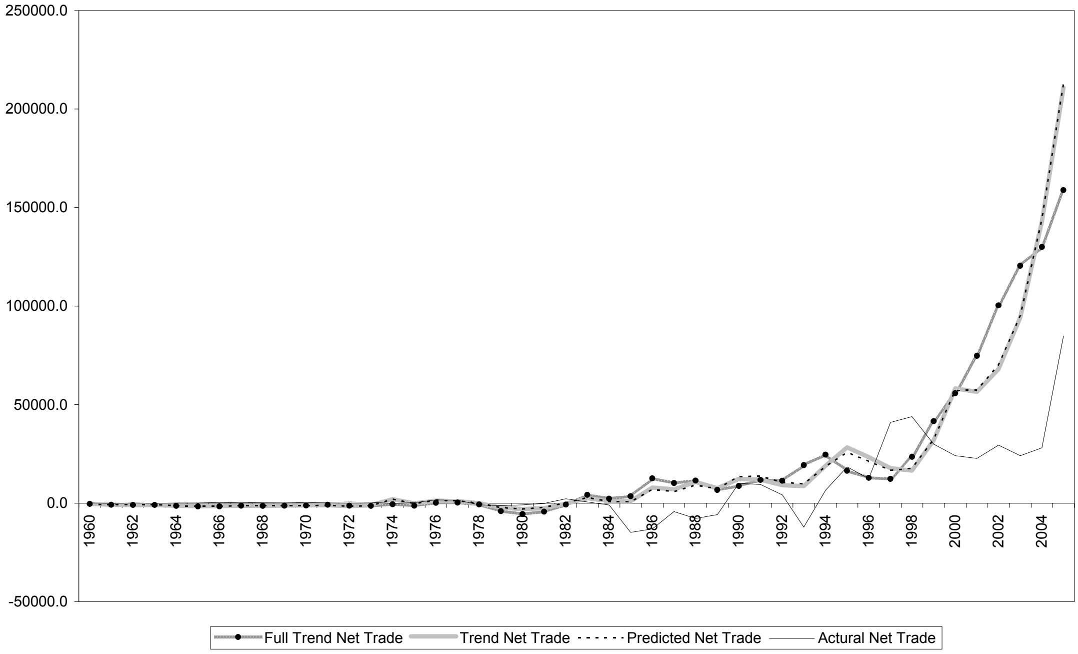


Figure 4. Sustainable (SCAY), Trend (TCAY) and Actual (CAY) Current Account (as a percentage of GDP)

Figure 5. Nominal FEER and Actual Nominal Bilateral CNY/USD Exchange Rate (N)

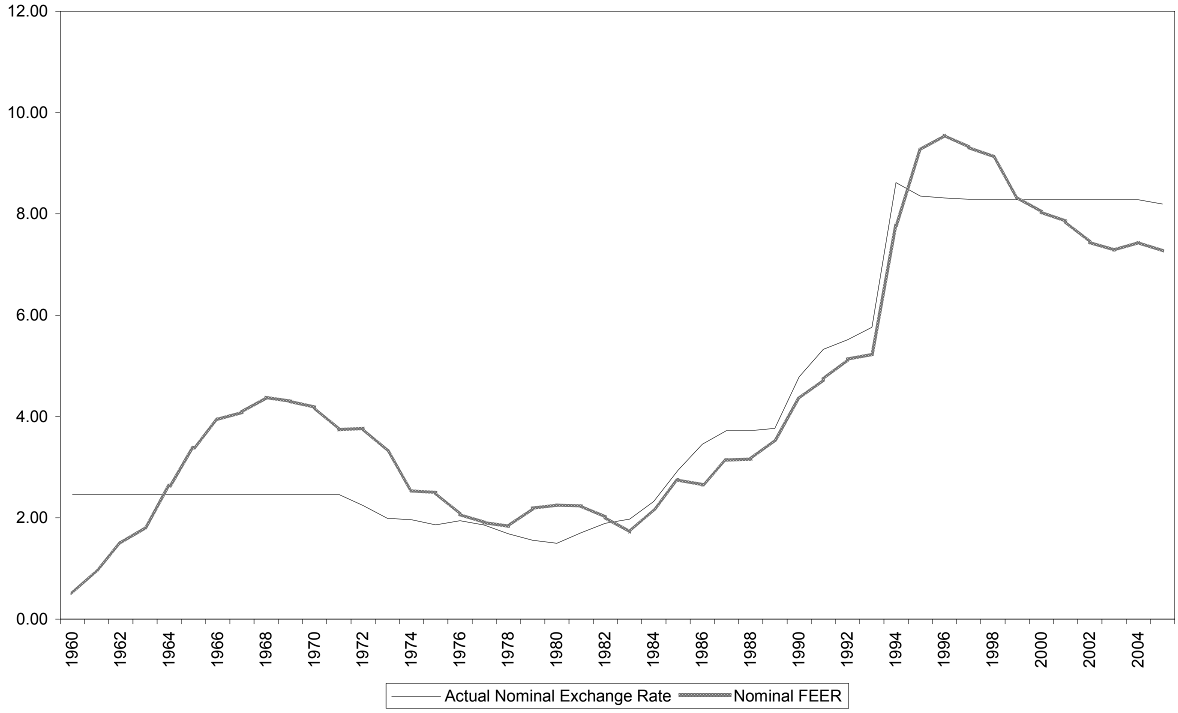
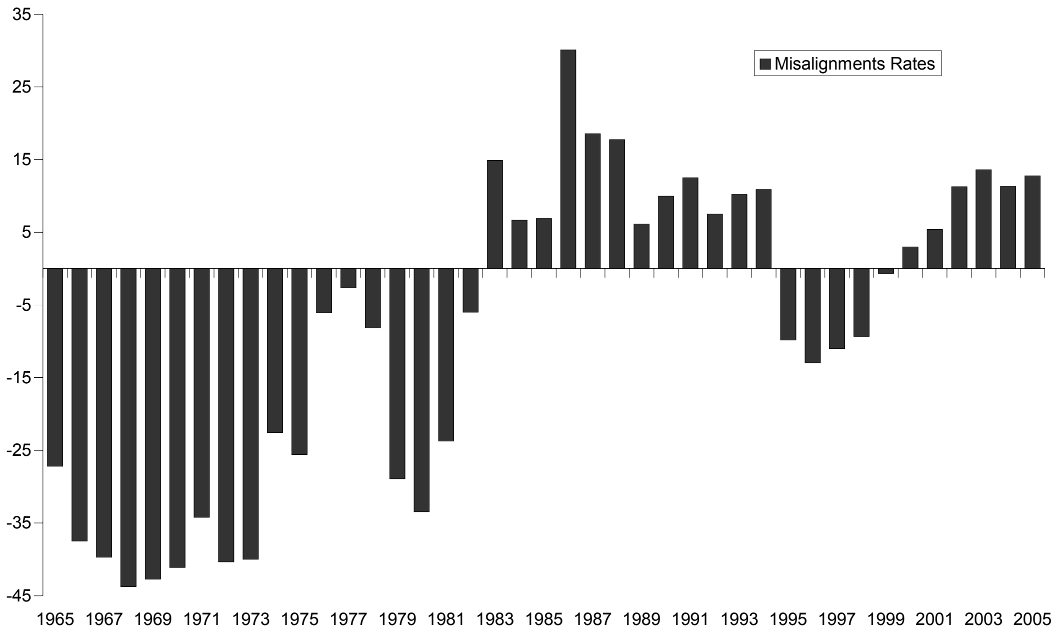


Figure 6. Misalignment Rates between Actual Nominal Bilateral CNY/USD Exchange Rate and Nominal FEER (%)



Note: Misalignment rate=(N-FEER)/FEER*100%; a positive (negative) misalignment rate implies an undervaluation (overvaluation) of the nominal RMB.